

ORIGINAL ARTICLE

A Study of How Living and Learning Centres Affect Students' Development in STEM Education: A Quasi-experimental Analysis Model

Su Youn BYOUN¹

¹ Busan University of Foreign Studies, South Korea

Address for Correspondence: Dr Su Youn Byoun, Busan University of Foreign Studies, 65, Geumsaem-ro 485beon-gil, Geumjeong-gu, Busan, South Korea

Email: sybyoun524@gmail.com

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A Study of How Living and Learning Centres Affect Students' Development in STEM Education: A Quasi-experimental Analysis Model

ABSTRACT

This study examines how living and learning centres (LLCs) affect the academic development of college students who study science, technologies, engineering, and mathematics (STEM) disciplines in comparison to traditional residence halls. A quasi-experimental analysis model was implemented to compare the effects of different types of halls of residence of two Korean STEM colleges on three levels of student development. Analyses revealed that LLCs are more effective than traditional halls of residence in the higher stage of development. In promoting student engagement in terms of responding to academic challenges, faculty-student interaction, and having an appreciation of a supportive learning environment, the LLC was found to be more influential than the traditional residence programme. These findings suggest that STEM-focused LLCs can be an effective alternative for Asian STEM education institutions that want to create a learning environment which promotes the holistic development of their students.

INTRODUCTION

Living and learning centres (LLCs), or residential college programmes, are widely known as one of the most effective learning environments facilitating college students' holistic development. The Association of American Colleges and Universities (AAC&U) has designated living-learning programmes (within the learning community category) as a 'high impact practice' (Kuh, 2008). A high degree of diversity exists in the description and implementation practices of LLCs. However, LLCs can be generally defined as intentionally structured residential communities in which participants: (a) live together in a hall of residence on campus, (b) partake in a shared academic curriculum and/or co-curriculum, and (c) have access to special resources in their residence environment that are available primarily to them (Soldner, Rowan-Kenyon, Inkelas, Garvey, & Robbins, 2012, p. 313).

Originating from the British residential colleges, LLCs have enjoyed a renaissance in the U.S. since the 1980s. LLCs were introduced to many American colleges and universities as a reform project for ailing undergraduate programmes (Soldner et al., 2012). Propelled by its remarkable success in American colleges and universities, LLCs have been adopted in other countries. However, LLCs implemented outside the U.S have scarcely been researched.

In Asia, colleges and universities in Hong Kong, Singapore, and Korea have demonstrated a strong interest in importing this new practice, in which academic and co-curricular programmes are integrated. In Korea, universities focusing on science, technologies, engineering, and mathematics (STEM) education are particularly active in introducing LLCs to their educational programmes. For example, Pohang Science and Technology University (POSTECH), one of the most advanced research-oriented STEM institutions in the world, was one of the first universities in Korea to introduce an LLC in its freshmen hall of residence in 2008. The strongest rationale behind this initiative was that the philosophy and strengths of the LLC, namely its positive effects on academic performance and community-building, were well suited for meeting the academic needs of Korean STEM students. Although issues of student attrition and low degree attainment are not as serious for Korean STEM education institutions as those in the U.S., Korean STEM institutions have been concerned with a continuous increase of students who fail in college learning. The number of students on academic probation or choosing to take a leave of absence due to underachievement have continued to increase over the last few decades. One prestigious STEM college in Korea even experienced a series of student suicides because of stress and depression. In this context, LLCs which aim to develop students' social and cognitive skills look to be an ideal cure for higher education institutions (STEM or regular) that are concerned with such student-related issues.

In spite of this heightened interest and investment in LLCs outside of the U.S., research studies which examine the impact of LLCs on Asian higher education institutions have been few and far between. LLCs of STEM programmes have been even more scarcely researched. Difficulties in empirically analysing the effects of LLCs in experimental or quasi-experimental models and the insufficient secondary data of college students may have hindered academic interest in this topic. This study, which analyses quantitative data on the engagement of Korean STEM students, aims to fill this research gap, and provide STEM colleges and other post-secondary institutions with useful empirical information to facilitate decision-making processes related to residential education. More specifically, this study examines whether a LLC-hall of residence is more effective in achieving the three purposes of the learning environment than a conventional hall of residence in the Korean context.

THEORETICAL FRAMEWORK

Living-and-learning centres (LLCs)

Previous literature on learning environments in post-secondary education regard LLCs as one of the most influential learning practices (Inkelas, Garvey, & Robbins, 2012; Kuh et al., 2005). Many researchers view LLCs as one type of learning community in colleges and universities (Inkelas, Soldner, Longbeam, & Leonard, 2008). With other types of learning communities such as linked courses, team-taught courses, or freshmen interest groups, LLCs surely form a critical part of the physical and social learning environment surrounding college students.

Studies on LLCs' effects on learning outcomes originated from research on the hall of residence experience. Students residing on campus, whether in an LLC or not, were reported to have had better learning outcomes than commuting students (Astin, 1993; Pascarella & Terenzini, 2005). Even in comparison to traditional forms of campus residence, LLCs were found to generate better college outcomes. The LLC experience improves students' academic performance (Purdie, 2007; Stassen, 2003), increases retention rates (Pike, Schroeder & Berry, 1997; Purdie, 2007), and facilitates intellectual development (Inkelas et al., 2006; Inkelas, Daver, Vogt, & Brown-Leonard, 2006; Kohl, 2009; Pike, 1999). In the social domain, the LLC environment promotes faculty-student interaction (Garrett & Zabriskie, 2003; Inkelas et al., 2007) as well as peer interaction (Inkelas et al., 2006) more effectively than non-LLC residence programmes. Extensive research by the National Study of Living-and Learning

Programmes (NSLLP) of more than 45,000 undergraduate students reported that LLC students experience higher levels of social and academic support within their residence halls compared to peers living in traditional hall of residence environments. LLC students more frequently discuss academic, vocational, and social/cultural issues with peers and experience more interaction with faculty than the control group (Inkelas et al., 2007). In summary, LLCs are highly effective in facilitating smooth college transitions, increasing self-efficacy, and enhancing immersion into the college community.

STEM education and LLCs

STEM education institutions in America have been concerned about various barriers to student success. Even though STEM fields are recognised to be linked to a nation's long-term prosperity, less and less students in the U.S. opt to study STEM majors and even worse, only a few of them graduate with STEM degrees (Kokkelenberg & Sinha, 2010; National Academies of Science, 2006; U.S. Department of Education, 2009). Dropout rates are high among STEM undergraduates, particularly among women and ethnic minorities in computer science and engineering degree programmes (National Science Foundation, 2010). Therefore, it is not surprising that institutions have developed LLCs that exclusively target students interested in STEM majors. Of the 650 LLCs that the NSLLP investigated, 89 programmes were for STEM students (Soldner et al., 2012). Under the NSLLP's categorisation, STEM-focused programmes were frequently found in the LLC group for women's education, because many STEM institutions are operating LLCs in an attempt to support female STEM students who show high levels of attrition.

The literature on STEM-focused LLCs has reported that the efficacy of LLCs is valid in STEM education. Helman (1999) argued that the LLC experience facilitates students' adjustment to college life, and Johnson (2007) highlighted the LLC's effect of enhancing a sense of belonging among STEM students. Gandhi (1999) investigated the positive relationship between the LLC experience and students' persistence in STEM fields. In the same vein, Soldner et al. (2012) reported on the STEM-focused LLC's indirect impact on students' self-reported likelihood of completing a STEM baccalaureate compared to those in a traditional hall of residence. However, there is still a dearth of information when it comes to an examination of the relationship between STEM-focused LLCs and student learning, whether in higher education institutions in the U.S. or in other places. In Korea, where LLCs are still unfamiliar, academic interest in STEM students' LLC experiences have only just started.

Ecological perspectives of LLCs

It is not a simple task to examine how complex learning environments such as LLCs affect students' learning and development. Apart from some quantitative outcomes such as students' grade point average (GPA) scores or degree attainment, what are meaningful and relevant outcomes of attending an LLC? Is the LLC an intervention-like programme, or more of a physical environment equipped with some human factors? Can we examine the LLC's effects immediately after implementation, like in other interventions, or if not, how long do we need to wait? For these questions, system theories that focus on comparing output to the amount of input do not appear to give easy or plausible answers. In fact, many components of an LLC can change over time through the interaction with students who reside there. Therefore, an ecological perspective that highlights environmental influences on the fundamental and comprehensive development of humans (and reverse influences) offers a more useful analytical lens to understand the phenomena in LLCs. Strange and Banning (2001), from a human-environment perspective, maintained that educational institutions should intentionally design their physical, human aggregate, organisational, and constructed environments in order to facilitate student learning and development. They described student development in three levels, which are interpreted as three goals that campus environments should aim to achieve (see Figure 1).

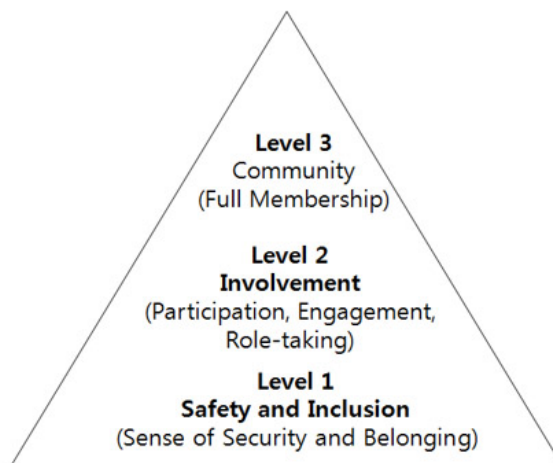


Figure 1. A hierarchy of learning environment purposes. (Strange & Banning, 2001, p.109)

This framework, based on the famous hierarchy of human needs by Maslow (1968), supposes that students develop from feeling a sense of safety and inclusion via the second stage of active involvement in learning activities to the final stage of exercising full membership of their community. Applying this theory to LLCs, I propose that LLCs are more effective in achieving these three purposes of learning environments than traditional halls of residence. This study examines whether the proposition is supported by empirical data. The specific hypotheses are listed as follows:

- **Hypothesis 1:** LLC implementation in a STEM college enhances students' sense of inclusion more effectively than conventional residence programmes.
- **Hypothesis 2:** LLC implementation increases students' engagement in various learning activities more effectively than conventional residence programmes.
- **Hypothesis 3:** LLC implementation more effectively promotes students' intention to contribute to their institution after graduation than conventional residence programmes.

METHODS

Samples and instruments

In order to compare the aforementioned effects of the LLC with non-LLC halls of residence, I chose two science and technology universities in Korea. These two STEM colleges offer on-campus accommodation for most of their undergraduates, but only one is running its hall of residence as an LLC. This college, named the LLC College, is operating a LLC in a hall of residence for freshmen and junior students. It appoints a master professor for each floor (altogether thirteen faculty members at the LLC), who is expected to meet and dine together with his or her students a couple of times each semester and provide counsel if necessary. On each floor, two residence assistants (RAs) reside and manage various student affairs, including regular LLC activities. In 2014 to 2015, for example, the LLC College organised various formal and informal activities (see Table 1).

Table 1
Sample of LLC College group activities

Activities	Frequency
Group viewing of famous musicals	3 times
Sports activities (e.g., zip-lining, water-skiing)	2 times
Group tours to cultural and natural attractions	2 times
Group community service	weekly
Special lectures	2 times

The Non-LLC College featured in this study has a shorter institutional history than the LLC College. In many ways, the Non-LLC College has introduced various curricular and co-curricular programmes that the LLC College has conducted for years. However, the Non-LLC College has not yet started to convert its halls of residence into LLCs¹. This means that the Non-LLC College, as a conventional sleep-and-eat dormitory, does not have an LLC department consisting of master professors and residential assistants that plan and implement group activities.

This study implemented a quasi-experimental analysis based on a control group (the Non-LLC College) and an experimental group (the LLC College). The Korean version of the National Study of Student Engagement (K-NSSE) was administered to students of the two institutions in December 2013. The K-NSSE, developed by Bae and Kim (2012) on the basis of the American NSSE (National Survey of Student Engagement), consists of 74 questions covering six areas of student engagement in learning: responding to academic challenges, intellectual stimulus, active and collaborative learning, faculty-student interaction, peer relationships, and having an appreciation of supportive learning environments. Apart from basic demographic data of participating students, the K-NSSE collects information about the extent of satisfaction with college education and organisational commitment. K-NSSE items were measured on four- to seven-point Likert scales.

¹ In the Korean context, halls of residence, even in the case of LLCs, are to a large extent managed independently from academic departments. Therefore, those co-curricular activities that the Non-LLC College have implemented in the individual department level or the college level, such as the entrepreneurship camp or overseas community service programmes, cannot be regarded as residential community activities. As a matter of fact, halls of residence of the Non-LLC College do not offer any co-curricular activities.

Of the 324 students who completed the survey, 268 cases with no missing data were included in the final sample: 151 cases were collected from the Non-LLC College and 117 cases from the LLC College. Table 2 presents demographic information of the two samples and the results of the initial statistical analysis of group differences.

Table 2
Descriptive statistics for the Non-LLC and LLC Colleges

		Non-LLC College		LLC College		Analysis of difference
		N	%	N	%	
Gender	Female	56	36.4%	20	17.1%	$\chi^2 = 12.222,$ $p = .001$
	Male	99	63.6%	97	82.9%	
Type of high school	Regular HS	129	85.4%	86	73.5%	$\chi^2 = 5.910,$ $p = .020$
	STEM HS	22	14.6%	31	26.5%	
Year	1st year	12	7.9%	16	13.7%	$\chi^2 = 9.626,$ $p = .022$
	2nd year	53	35.1%	36	30.8%	
	3rd year	48	31.8%	22	18.8%	
	4th year	38	25.2%	43	36.8%	
Total(N)		151	100.0%	117	100.0%	
High school GPA (M/SD)		8.12/1.35		8.42/1.12		$t = -1.935,$ $p = .0535$
College GPA(M/SD)		3.46/.53		3.35/.65		$t = 1.608,$ $p = .109$

Variables and analysis

A one-way analysis of covariance (ANCOVA) was conducted to investigate the LLC's influence on the first and third levels of student development. For the second level, a one-way multivariate analysis of covariance (MANCOVA) was executed because the K-NSSE assumes that the construct of student engagement has six dimensions or sub-factors.

To measure the LLC's effect on Level 1 (safety and inclusion), responses to the question "How much do you think that you are included into your college community?" were used as the dependent variable. For Level 2 (involvement), the sums of the six areas of student engagement were used as dependent variables. For Level 3 (community), responses to the question asking about the intention to contribute after graduation were used as the dependent variable. The content and structure of dependent and control variables are presented in Table 3.

Table 3
Description of dependent variables and covariates

	Category	Content
DV	Level 1 Safety and Inclusion	Sense of inclusion How much do you think that you are included in your college community?
	Level 2 Involvement	Academic challenge Weekly hours used in learning Number of completed assignments of reading and writing per semester Number of completed writing assignments (< 5 pages) Number of completed writing assignments (5+ pages) Do you think that you have studied up to the expectations of instructors?
		Intellectual activities The degree that analysis is stressed in class The degree that comprehensive thinking is stressed in class The degree that judgment is stressed in class The degree that application is stressed in class The extent that your college stresses learning and completing assignments
		Active- and collaborative learning Frequency of presentation in class Frequency of project learning with peer students Frequency of learning with peers after class The extent of utilization of IT devices
		Faculty- student interaction Discussion of learning content, assignment and grades with instructors in and after class Experience of receiving feedback on your assignment from instructors Faculty coaching about your career building Experience of conducting extra-curricular activities with faculty members Quality of faculty-student relationship
		Peer relationship Teaching of peers Sense of intimacy and support Conversation with students on religious, political and social issues Discussion of what you have learned in class with peers who did not take the same course
		Supportive environment Does your college eagerly support student success? Does your college support extra-curricular activities? The degree of support-oriented attitudes of college staff
	Level 3 Community	Intention of contribution Do you intend to make financial contribution to your college or take part in the alumni association after graduation?

	Gender	Dummy variable (female = 0, male = 1)
	Type of high school(HS)	Dummy variable (regular HS=0, STEM HS = 1)
CV	College year	Continuous variable from 1 st to 4 th year
	High school GPA	Continuous variable from 1 to 9
	College GPA	Continuous variable from 1 to 4

RESULTS

Level 1: Safety and inclusion

The first hypothesis of this study examines if LLC implementation in a STEM college enhances students' sense of inclusion more effectively than conventional residence programmes. The descriptive statistics of variables of Level 1 are presented in Table 4.

Table 4

Group means for sense of inclusion

Group	N	M	SD
Non-LLC	151	4.03	.812
LLC	117	4.22	.948
Total	268	4.12	.877

A one-way ANCOVA was conducted to determine the effect of LLC implementation on sense of safety/inclusion when controlling for gender, type of high school, college year, high school GPA, and college GPA. The ANCOVA was non-significant ($F = 2.081$, $p = .100$, partial $\eta^2 = .010$). None of the five covariates significantly influenced students' sense of inclusion (see Table 5). The hypothesis that LLC implementation would promote their sense of inclusion into a college community more effectively than conventional residence programmes was not supported.

Table 5
ANCOVA results on respondents' sense of inclusion as a function of LLC implementation

	Source	df	MS	F	p	η^2
Covariate	Gender	1	.387	.506	.477	.002
Covariate	HS Type	1	.137	.179	.673	.001
Covariate	College Year	1	1.222	1.600	.207	.006
Covariate	HS GPA	1	.190	.249	.618	.001
Covariate	College GPA	1	2.018	2.643	.105	.010
IV	LLC	1	2.081	2.726	.100	.010

Level 2: Involvement

To identify differences in student involvement due to LLC implementation, a one-way MANCOVA was conducted (with gender, high school type, college year, high school GPA, and college GPA as covariates). The results revealed a significant main effect for LLC implementation. Table 6 shows that in four of the six sub-scales of student engagement, the LLC College indicates a higher level than the Non-LLC College. The Non-LLC College demonstrated higher scores than the former only in the active- and collaborative learning scale and the faculty-student interaction scale.

Table 6
Descriptive statistics of student engagement

Sub-factor	Group	M	SD	Sub-factor	Group	M	SD
Academic challenge (AC)	Non-LLC	11.430	3.424	Peer relationship (PR)	Non-LLC	11.179	2.400
	LLC	12.872	3.628		LLC	11.872	2.890
	Total	12.060	3.581		Total	11.481	2.643
Intellectual activities (IA)	Non-LLC	15.159	2.522	Faculty-student interaction (FSI)	Non-LLC	15.325	3.989
	LLC	15.701	2.567		LLC	13.957	3.699
	Total	15.396	2.551		Total	14.728	3.917
Active- and collaborative learning (ACL)	Non-LLC	11.960	2.785	Supportive Environment (SE)	Non-LLC	9.040	2.441
	LLC	11.453	2.401		LLC	10.761	1.998
	Total	11.739	2.632		Total	9.791	2.411

The MANCOVA, with LLC implementation as the independent variable and gender, high school type, college year, high school GPA, and college GPA as covariates, indicated a statistically significant difference between the two colleges ($F = 13.653, p < .000$). Univariate F s revealed significant group differences on responding to academic challenges, faculty-student interaction, and students' appreciation of supportive environments (see Table 7). The LLC implementation was found to be more effective in reinforcing an appreciation of supportive environments and encouraging students to take academic challenges compared to traditional residence halls. Surprisingly, however, faculty-student interaction was negatively associated with the LLC. This finding suggests a low degree of faculty participation in the LLC of the LLC College. Although floor master professors had been appointed and they met students regularly, their interaction with students seemed to be limited to a large extent. In fact, most of the LLC programmes at the LLC College were planned and conducted by residence assistants and residing students. Therefore, the higher faculty-student interaction score observed in the Non-LLC College can be explained by differences in the faculty-student interaction culture of the two colleges. While no statistically significant differences were found between the colleges on intellectual stimulus, the active and collaborative learning ($F = 3.158, p = .077$) and peer relationship sub-factors ($F = 3.544, p = .061$) showed marginally significant differences in the predicted direction. These results partly support the hypothesis that LLC implementation would enhance students' engagement in learning.

Table 7
MANCOVA results on respondents' engagement as a function of LLC implementation

Source	DV	df	MS	F	p	η^2	Source	DV	df	MS	F	p	η^2
Gender	AC	1	8.978	.732	.393	.003	High School GPA	AC	1	13.216	1.077	.300	.004
	IA	1	9.443	1.509	.220	.006		IA	1	25.706	4.108	.044	.015
	ACL	1	11.516	1.699	.194	.006		ACL	1	29.309	4.324	.039	.016
	PR	1	5.978	.885	.348	.003		PR	1	2.898	.429	.513	.002
	FSI	1	.319	.022	.883	.000		FSI	1	16.068	1.100	.295	.004
	SE	1	1.372	.275	.601	.001		SE	1	3.757	.752	.387	.003
High School Type	AC	1	.757	.062	.804	.000	College GPA	AC	1	47.780	3.893	.050	.015
	IA	1	31.135	4.975	.027	.019		IA	1	26.136	4.176	.042	.016
	ACL	1	20.498	3.024	.083	.011		ACL	1	2.299	0.339	.561	.001
	PR	1	1.584	.235	.629	.001		PR	1	54.964	8.141	.005	.030
	FSI	1	29.624	2.027	.156	.008		FSI	1	19.024	1.302	.255	.005
	SE	1	1.015	.203	.653	.001		SE	1	11.215	2.245	.135	.009
College year	AC	1	4.688	.382	.537	.001	Non-LLC vs LLC	AC	1	107.132	8.729	.003	.032
	IA	1	1.056	.169	.682	.001		IA	1	4.461	.713	.399	.003
	ACL	1	14.087	2.078	.151	.008		ACL	1	21.404	3.158	.077	.012
	PR	1	.325	.048	.827	.000		PR	1	23.929	3.544	.061	.013
	FSI	1	92.768	6.348	.012	.024		FSI	1	129.937	8.892	.003	.033
	SE	1	34.179	6.843	.009	.026		SE	1	166.076	33.25	.000	.113

Community

A one-way ANCOVA was used to determine the effect of LLC implementation on students' intention to contribute to the college community (controlling for gender, type of high school, college year, high school GPA, and college GPA). Students who attended the LLC College demonstrated a higher intention to financially contribute to their college after graduation than those from the Non-LLC College (see Table 8).

Table 8
Group means for intention of contributing after graduation

Group	N	M	SD
Non-LLC	3.79	.838	151
LLC	4.05	.927	117
Total	3.90	.886	268

Results of the ANCOVA were significant ($F = 6.560, p = .011, \text{partial } \eta^2$), revealing that the LLC students were more eager to contribute to their institution in the future than the non-LLC students. The partial η^2 shows that LLC implementation accounts for approximately 2.5% of the variance of the dependent variable (see Table 9). Therefore, the hypothesis that LLC implementation more effectively promotes students' intention to contribute to their institution after graduation than conventional residence programmes was supported.

Table 9

ANCOVA results on respondents' intention of contributing after graduation as a function of LLC implementation

	Source	df	MS	F	p	η^2
Covariate	Gender	1	.003	.004	.951	.000
Covariate	HS type	1	.347	.453	.502	.002
Covariate	College Year	1	1.176	1.535	.216	.006
Covariate	HS GPA	1	.032	.041	.839	.000
Covariate	College GPA	1	4.101	5.356	.021	.020
IV	LLC	1	5.024	6.560	.011	.025

Limitations

Although the present study presents interesting findings about the educational effects of the LLC on STEM students based on an empirical research design, it has limitations. The most critical limitation is that, in this model, other differences between the two STEM colleges other than the LLC implementation in their residence halls were not properly controlled. Differences in organisational culture and climate, institutional history, academic curriculum and co-curriculum, and many other factors were not taken into account in the quasi-experimental model. The surprising finding that the faculty-student relationship was higher in the Non-LLC College than the LLC College was one of the results which suggests that this model has its limitations. Nevertheless, I believe that the findings of this study are still meaningful because of two contextual factors related to the two institutions. First, even if the two colleges can differentiate themselves from each other in many ways, academic programmes and organisational structures of STEM education institutions in Korea are highly homogeneous. Second, the important institutional factors of the two colleges were assumed to be particularly similar due to a special context in which the Non-LLC College, a newly-established STEM college, had benchmarked the LLC College's academic- and other co-curricular programmes as it strives to catch up with the frontrunner. In fact, the Non-LLC College invited a former professor of LLC College to be their first president. When

other physical conditions of the two colleges, such as their rural location, the campus size, educational facilities and so forth, are considered similar, I judged the LLC implementation to be an important dividing factor between the two colleges.

DISCUSSION AND CONCLUSIONS

The findings of the present study provide interesting information about the effects of LLC implementation on student development in colleges and universities. First, LLC implementation did not influence students' sense of inclusion in their college community compared to a traditional hall of residence. However, it did affect some areas of student engagement and more importantly, the transition to becoming a full-fledged member of the college community. LLC implementation was found to foster students' attitudes of actively meeting the academic challenges that their institution provides. It also encouraged an appreciation for their learning environment. Finally, students who had experience with LLCs tended to show a stronger intention to give back to their college than the non-LLC students.

These findings suggest that LLC programmes are more effective than conventional residence programmes in facilitating higher levels of development. As previous literature on hall of residence experiences have argued, students who live on campus feel a stronger sense of belonging and inclusion into the college community than commuting students. In other words, on-campus accommodation is already effective enough to develop those feelings among students. However, the sleep-and-eat model of conventional halls of residence might not be enough to encourage student engagement in learning activities and help them become full-fledged members of their learning community. Even though faculty involvement in LLC programmes of the experiment group was highly limited in bringing forth meaningful educational effects, other factors of the LLC environment appeared to stimulate some areas of student engagement and a zeal to contribute to the college community.

Student engagement in learning and building a community of learners are particularly critical goals for STEM education, where many students struggle for academic survival. It is promising that many individual difference variables, especially gender, did not exercise too much influence on levels of engagement and a zeal to contribute. Instead, LLC implementation, as one important institutional factor, made significant differences in STEM students' development. This finding is important, particularly in considering the group characteristics of Korean STEM students. Korean students majoring in STEM disciplines are generally regarded as introverted and individualistic (Byoun, 2014). They also have, to a certain degree, very independent or isolated learning

styles. In fact, many of them feel more comfortable studying on their own, and pursue individualistic life goals. Many of the problems of STEM students in Korea, whether serious or trivial, are related to these dispositions and learning styles. In this context, the finding that the LLC promotes community building and engagement implies that the problems Korean STEM students experience can be solved or alleviated by the comprehensive approach that LLCs suggest. Unfortunately, much work remains to be done in this area. Even in institutions where there is heavy investment in the implementation of LLCs, the work involved to analyse the actual effects of this new intervention is easily neglected. This study suggests that further research on the impact of STEM-focused LLCs on student learning should follow. It would be useful to collect more extensive data on students and faculty members residing in LLCs for future empirical studies that examine LLC's learning outcomes in a more rigorous manner. There should also be a closer investigation of each level of student development in STEM-focused LLCs and looking into ways to improve their LLC programmes. Faculty involvement in LLCs seems to be one of the key issues in improving the LLCs of research-oriented STEM institutions in Korea. Future research should investigate which aspects of faculty involvement in LLCs affect STEM students' development and how STEM institutions can encourage faculty members, who are usually preoccupied with heavy research burdens, to participate more actively in LLC programmes. Such studies can provide STEM institutions and various stakeholders with useful information to facilitate their organisations' decision-making processes related to residential education.

ABOUT THE AUTHOR

Su Youn BYOUN is an assistant professor at the Busan University of Foreign Studies. Her research interests include college impact theory and studies on enhancing classroom student engagement. She is currently a Director at the University's Centre for Educational Evaluation and Innovation in charge of data-based quality assurance.

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